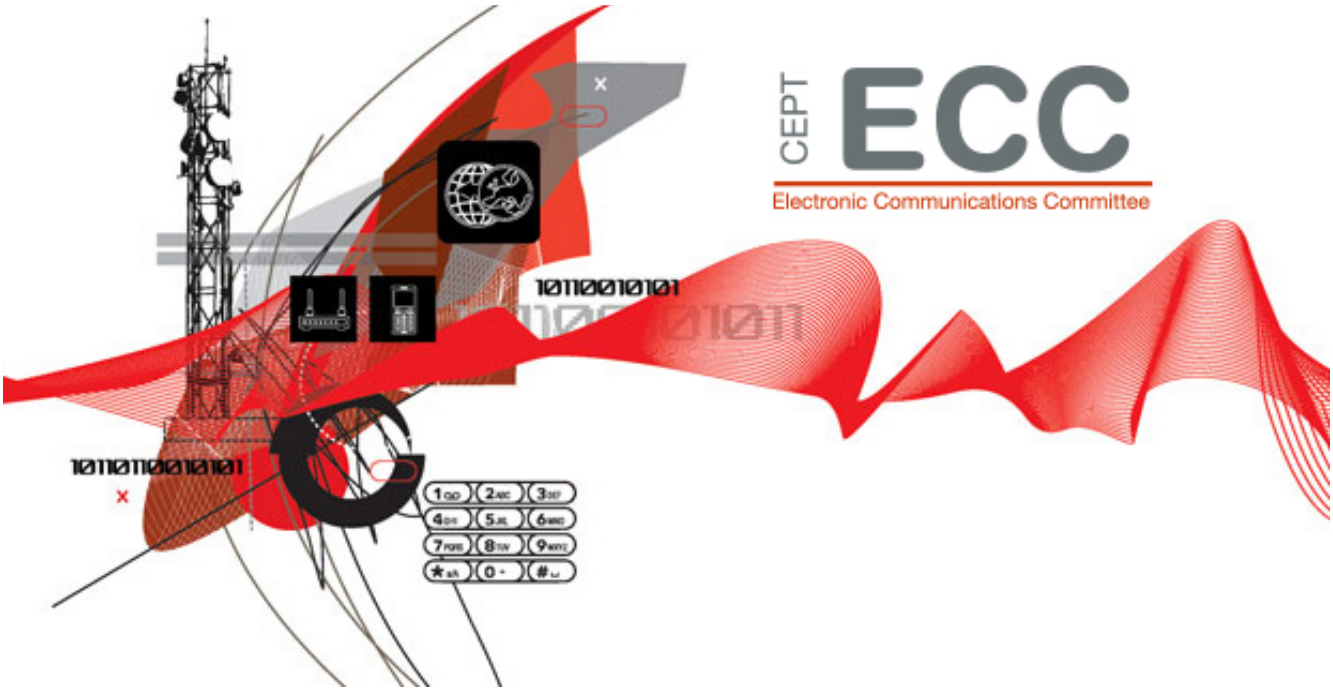


ECC Newsletter May 2022

ECC introduces regulation to operate autonomous maritime radio devices

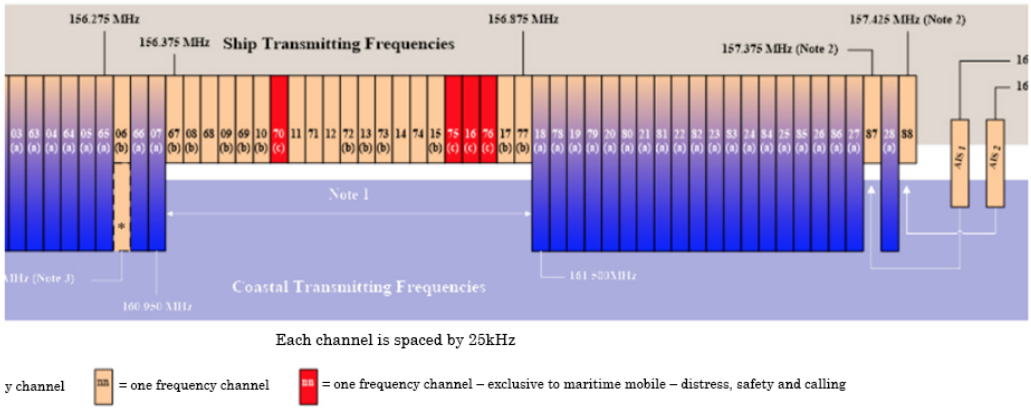
As radio devices at sea become more common, the Electronic Communications Committee (ECC) has moved to ensure that safety is put to the forefront of spectrum use, writes Robin Donoghue, ECO Expert in Spectrum Management

The safety of people working at sea and those who simply enjoy sailing is of paramount importance. In recent years, advances in technology have led to several innovations to enhance safety of navigation for both the pleasure sailor and those operating small commercial vessels. Among those innovations have been man-overboard devices, which have become more accessible, smaller, more reliable and more integrated into the vessel.

They have been produced under the watchful eye of the International Maritime Organization (IMO), which is responsible for the International Convention for the Safety of Life at Sea (SOLAS), a convention that has provided a framework for safe maritime operations for many years.

Man-overboard devices operate in the VHF radio spectrum. This gives the best compromise between range and information while the user is able to successfully operate and detect the casualty floating on the waves.

The use of the VHF spectrum by maritime users is set out in International Telecommunications Union (ITU) Radio Regulations Appendix 18, the "Table of transmitting frequencies in the VHF maritime mobile band".



Frequency arrangements for RR Appendix 18 (Source ITU-R M.2231)

Yet, there was an unintended consequence of the creation of devices using the VHF spectrum: their proliferation led to the creation of applications that were not envisioned by the maritime industry with safety in mind. For example, as fishing buoy markers entered the market, they started using the VHF radio spectrum.

Several CEPT administrations reported concerns that signals from non-safety applications could mask or interfere with signals originating from someone who had fallen overboard and was in distress. The issue had therefore become a priority for the enforcement agencies of many countries internationally, including several CEPT administrations.

- As a consequence, the World Radiocommunication Conference 2019 (WRC-19) agreed to regulate the use of autonomous maritime radio devices (AMRDs) in order to enhance safety of navigation and to ensure the integrity of the Global Maritime Distress and Safety System, the international integrated communication system for distress and safety at sea.

  WRC-19 concluded that only AMRD Group A – man-overboard devices with digital selective calling and mobile aids for navigation – are permitted to use Radio Regulations Appendix 18 frequencies which are allocated for digital selective calling and automatic identification systems. In the case of digital selective calling, those frequencies include Channel 70 (156.525 MHz), AIS 1 (161.975 MHz) and AIS 2 (162.025 MHz). Put simply, AMRD Group A enhance the safety of navigation.
- WRC-19 concluded further that AMRD Group B – all other types of AMRDs, including basic man-overboard devices without digital selective calling - may only use the frequency 160.900 MHz (channel 2006). Devices within AMRD Group B are limited to a transmitter e.i.r.p. of 100 mW and an antenna height not exceeding 1 metre above the surface of the sea.

Underpinning the work of the WRC-19 are several ITU-R recommendations in the "M" series of recommendations for the "Mobile, radiodetermination, amateur and related satellite services". These include M.2135, M.1371, M.493 and M.585. In particular, the M.585 sets out the "Assignment and use

of identities in the maritime mobile service". This is of particular interest to CEPT administrations as it sets out the common global system for uniquely identifying any man-overboard device - in effect the number identity of the AMRD.

In October 2020 the Working Group on Frequency Management (WG FM) recognised that the conclusion of the WRC-19 presented the opportunity to develop an ECC Decision to regulate the use of AMRDs within CEPT administrations. In doing so, the WG FM also noted that they expected that the proliferation of AMRDs will continue. Twelve CEPT administrations, with substantial coastal and maritime industries, supported the creation of an ECC Decision to regulate the operation of AMRDs in the CEPT region.

The project team FM58 (Maritime) was instructed by the WG FM to develop a new ECC Decision for AMRD operation.

The resulting draft ECC Decision (22)02 was approved for public consultation in February 2022. There were no comments received during that publication, other than minor editorial corrections. It is therefore expected that the ECC will publish this new ECC Decision in July 2022.

The draft ECC Decision (22)02 largely follows the outcome of the WRC-19 and the associated ITU-R recommendations.

- It designates channels 70 (156.525 MHz), AIS 1 (161.975 MHz) and AIS 2 (162.025 MHz) of Radio Regulations Appendix 18 for safety-critical AMRD Group A devices.
- It designates channel 2006 (160.900 MHz) of RR Appendix 18 for (all other) AMRD Group B devices.
- It sets a time limit of 31 December 2024 for apparatus previously permitted to use channels AIS 1 and AIS 2 but do not meet the description of Group A devices to cease using these frequency channels.

The separation of channels between the man-overboard devices with digital selective calling in Group A and other devices in Group B, should prevent the radio signals of safety critical equipment being interfered with, thus improving the reliability of these essential devices.

What policymakers should consider when it comes to the 28 GHz frequency band

In this deep-dive into the 28 GHz band, Jaime Afonso, ECO Spectrum Expert, looks at the issues facing regulators when it comes to use it for different services

The global harmonisation of spectrum allocation is challenging especially when there is a need to balance the competing interests of different services and applications. For policymakers and regulators, it is important to carefully assess the technical and regulatory impact of spectrum designation in the face of evolving requirements for the various services and applications at stake. The demand for the 28 GHz frequency band – typically understood as 27.5-29.5 GHz range – is one such example.

The co-primary allocations for 28 GHz frequency band as listed in Article 5 of the International Telecommunications Union (ITU) Radio Regulations, comprises the fixed service (FS), fixed-satellite service (FSS), Earth-to-space and the mobile service (MS). In Europe, the harmonised framework for the use of 28 GHz frequency band only considers FS and uncoordinated FSS (Earth-to-space) earth stations. This was established in ECC Decision (05)01.

In addition, the European Allocation Table (ECA), the ERC Report 025, identifies the 28 GHz frequency band for the fixed and fixed-satellite (Earth-to-space) co-primary services. Incidentally, the frequency band 28.5 – 29.5 GHz is also identified for Earth exploration-satellite (Earth-to-space) on a secondary basis.

The ECA does not contain any allocation to the mobile service, so in Europe it is not available for mobile or 5G.

The 28 GHz frequency band in Europe

ECC Decision (05)01 provides a regulatory framework for the use of the 28 GHz frequency band through the designation of specific frequency sub-ranges for the FS and uncoordinated FSS earth stations as shown in Figure 1 below. The background of this ECC Decision reflects the need to facilitate the free circulation and use of uncoordinated FSS earth stations noting that part of the 28 GHz frequency band is also identified for use by high-density applications in the FSS, for example, ubiquitous very small aperture terminals (VSATs), in the Earth-to-space direction.

The high density systems are characterised by flexible, rapid and ubiquitous deployment of large numbers of cost-optimised earth stations employing small antennas with common technical characteristics. Moreover, ECC Decision (05)01 specifies the existing channel arrangement for the FS as detailed in CEPT Recommendation T/R 13-02. This is also the basis for the current FS deployment

in Europe as described in ECO Report 04. The majority of CEPT administrations have implemented this Decision, although the number and type of FS links operating in the bands identified for FS varies widely from country to country.

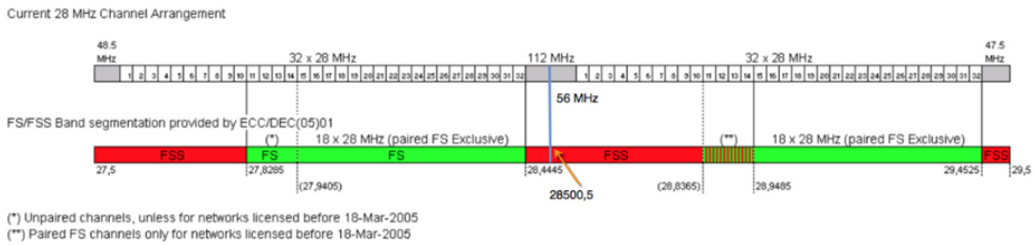


Figure 1: CEPT 28 GHz band plan

In this context, in spite of the band segmentation depicted in Figure 1, it is worth highlighting that ECC Decision (05)01 underlines that "coordinated FSS earth stations can still make use of the whole band 27.5-29.5 GHz, using established co-ordination procedures". This is a key aspect in the framework of the recent studies undertaken by CEPT in the 28 GHz frequency band.

Emerging applications

When ECC Decision (05)01 was developed there were no commercial satellites in operation in the so-called Ka-band – which includes the 28 GHz frequency band. The system parameters and technologies on which that Decision was based did not consider the key advances in the satellite field that underpin many of the wide range of satellite applications available nowadays. Indeed, improvements in satellite technology in recent years have led to a significant increase in throughput delivered from new High Throughput Satellite systems. As a side note, this frequency band was identified for the operation of "Earth stations in motion" at WRC-19.

High Throughput Satellite systems are expanding the capacity and capability of next-generation satellites to offer significant advantages in data transmission rates due to narrower beams, increased power and the ability to reuse the same frequencies with multiple steerable spot beams, increasing capacity in the assigned spectrum.

The Ka-band, typically comprising downlink frequencies at 17.7-21.2 GHz and uplink frequencies at 27.5-31 GHz, is widely seen as a core band for commercial high throughput satellite connectivity solutions.

The studies

CEPT's Project Team of the Working Group Spectrum Engineering (PT SE40) conducted the required studies to examine if advanced technologies and/or mitigation techniques could enable a wider range of fixed uncoordinated geostationary satellite orbit FSS earth stations and FS use in the 28 GHz band. The sharing and compatibility studies were conducted taking into account the existing protection requirements for both services.

One important characteristic of both the FS and the FSS services operating in this band is that the antenna patterns at this frequency are generally highly directive, meaning that the highest risk of interference occurs in a very limited range of azimuth and elevation angles. The studies analysed the existing usage of the FS band segments and explored the feasibility of using these frequencies by FSS earth stations through the classical interference Minimum Coupling Loss (MCL) calculations (see Figure 2 with the basic interference scenario).

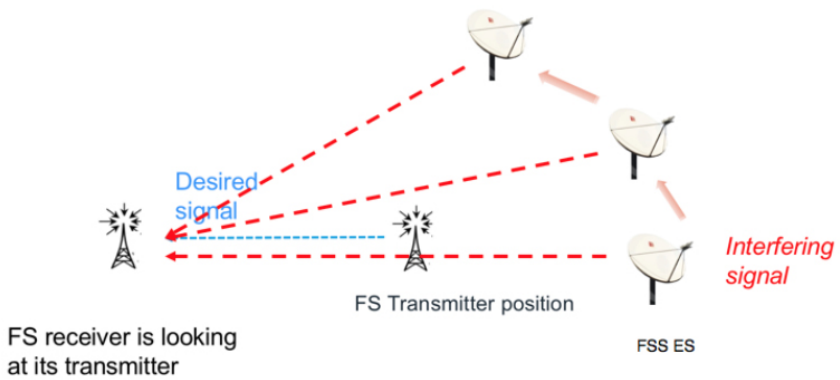


Figure 2: MCL calculations scenario

In addition, the studies considered the possibility of operation of typical uncoordinated geostationary satellite orbit FSS earth stations in the band segments where the FS is deployed by exploring the feasibility of using advanced techniques to enable opportunistic use by FSS earth stations, through active and passive mitigation techniques to protect the FS links. Potential interference avoidance techniques were assessed, such as "sense and avoid", the use of geolocation databases and shielding.

Spectrum sensing (including sense and avoid) is an active cognitive technique based on the principle that the cognitive device, prior to using the spectrum, "listens" to emissions of potential victim links. If their presence is detected, the device refrains from emitting.

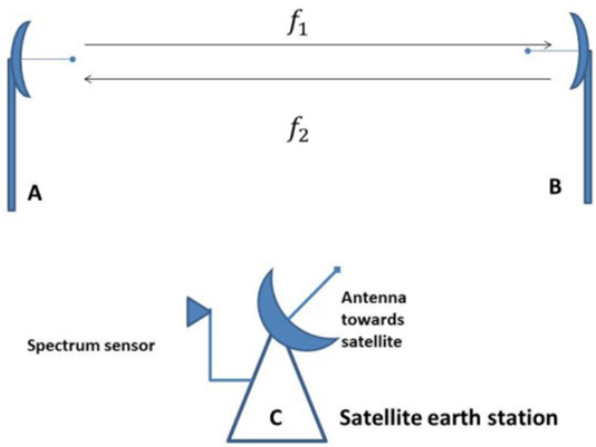


Figure 3: Spectrum sensing scenario

The findings of these in-depth research studies are contained in ECC Report 304 and their complementary studies in ECC Report 335.

Main outcomes

MCL calculations show that the directivity of antennas operating in the FS portions of the 28 GHz frequency band result in separation distances ranging from 0.3 km up to nearly 60 km. In case of uncoordinated FSS Earth Station deployment, this presents a risk of potential interference in areas where there is a high density of point-to-point links which would need to be mitigated.

The feasibility and performance of the geolocation database approach as an advanced mitigation technique is subject to the issue of data integrity, availability and accuracy. Its overall feasibility will depend on the specific situation of each country. Passive mitigation techniques can also be implemented; shielding is the most effective of these but requires professional installation.

In general, the sense and avoid technique offers advantages over the geolocation database and shielding approaches, because it does not require precise and up-to-date information on the FS systems, and it also can ensure coexistence with future FS developments. However, the sensing mechanism is based on the assumption that the channelisation of the FS in the band is known in advance and that the links are bi-directional. Generally, the feasibility of implementing spectrum sensing depends on the specific situation of each country and, in particular, the value of the FS output power that needs to be detected.

Although sensing could be an effective interference mitigation technique under certain conditions, protection of all operational FS links is challenging as this is constrained by the technical capability to set a lower sensor threshold level.

Administrations may deem it appropriate to use different values of FS output power for defining the requirements of the sensor, based on their specific deployment scenarios. In particular, studies conclude that the sensor threshold for a transmitter output power of -10 dBm needs to be set around

30-40 dB below the noise floor. Therefore, additional measures are required to improve the measurement sensitivity.

The combination of sensor antenna gain, sensor sensitivity and integration time are the main parameters to define the performance of the sensor. The overall feasibility of the sensing concept is therefore highly dependent on the possibility of improving these parameters, noting that this improvement could be limited due to effort, costs and physics.

Overall, the mitigation techniques mentioned above – to be further specified – should reduce the risk of interference into FS receivers to a point that use of FSS earth stations on an uncoordinated basis is feasible in the portions of the 28 GHz frequency band identified for FS use. Without those mitigation techniques, uncoordinated use of these portions of the band by the FSS is not feasible.